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**Designated Network Resource Service Request
IBR Study
for OASIS 95150056 (DNR) “St. Marks Solar”**



December 2021

Transmission Planning, Florida

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1. Executive Summary

As a member of the FRCC, DEF has been asked to conduct an Inverter Based Resource (IBR) study which includes other FRCC member entities' planned solar requests to assist them in assessing impacts to their system. The customer should note that this study may not follow DEF's interpretation of the Tariff and may not reflect request order in respect to this OASIS request thus impacts to DEF facilities were not considered in this study.

The System Impact for the Duke Energy Florida, LLC (DEF) Transmission System was studied for the Designated Network Resource (DNR) request referenced by OASIS number 95150056. This DNR requests a maximum of 75 MW yearly received from St. Marks Solar resource located in Wakulla County, Florida and delivered to DEF Load within DEF's Area beginning 01/01/2024 thru 01/01/2100. Although the requested start is 01/01/2024, current study work indicates that the NRIS study associated with this has an ISD of 09/03/2024. Therefore, this was the assumed ISD for this request. At the completion of this report, St. Marks Solar is still in its Large Generator Interconnection Procedures (LGIP) process under Q291 and working on the execution of a Large Generator Interconnection Agreement (LGIA) for 74.9 MW summer/winter.

The results of this IBR study did indicate that there are potentially impacted FRCC member entities. The customer will need contact these potentially impacted parties to confirm and resolve impacts to their system.

2. Point of Receipt, and Point of Delivery

The Point of Receipt is the generator referred to as "St. Marks Solar", with the Point of Interconnection will be a new 230 kV terminal at DEF's existing St. Marks East 230/69 kV substation located in Wakulla County, Florida.

The Point of Delivery is City of DEF's Load, which is located in DEF's Balancing Area.

3. Model Development

Power flow models were built using the Siemens PSS®E power system simulation program and were based on the FRCC 2021 (RIs2-RP) series cases, which were the most recent models available at the time of the study. The model years to be studied for power flow impacts will be 2024 Summer, and 2026 Summer. The study case models added the appropriate additional MW summer/winter output to each base case. Any sensitivity work performed was based on the FRCC 2021 (RIs2-RP) series cases.

This resource was studied as being dispatched against other DEF resources that would otherwise be serving DEF's Load.

4. Analyses Performed

Power flow analyses of the cases were performed using PowerGEM's TARA software (TARA) to determine the impact of the DNR on the Bulk Electric System (BES). The base and interconnection study cases were compared to determine if the DNR caused new overloads, voltage violations, or exacerbated existing thermal overloads. In addition, all 69 kV and above branch flows and bus voltages in the FRCC region were monitored.

The following contingencies were performed using the TARA AC Contingency Analysis Calculator:

- Selected TPL-001-4 Category P1, P2, P4, P5, P6 and P7 contingencies within the FRCC region as previously defined by FRCC transmission owners.

5. Screening Criteria

The following criteria were used for screening **thermal results**.

- Unrelated results from GSU transformers were excluded.
- Transmission system elements operated at less than 69 kV nominal voltage were excluded.
- System-intact overloads were screened at greater than 100 percent of rate A.
- Post-contingency overloads were screened at greater than 100 percent of rate A. An exception to using Rate A is the P6 contingencies, which were screened at Rate C.
- Post-contingency overloads that would be improved by the interconnection were excluded.
- Existing Post-contingency overloads were compared between the base and study cases, these overloads that increased were reviewed for significant impact.

The following criteria were used for screening **voltage results**.

- DEF and SECI buses were monitored for values outside of 0.90-1.05 p.u.
- FPL 69, 115, 138, and 230 kV buses were monitored for values outside of 0.95-1.07 p.u.
- FPL 500 kV buses were monitored for values outside of 0.95-1.10 p.u.
- TECO 69 kV buses were monitored for values outside of 0.925-1.05 p.u.
- TECO 138 and 230 kV buses were monitored for values outside of 0.95-1.06 p.u.
- FPL's Turkey Point bus voltage was monitored for values outside of 1.01 p.u. and 1.06 p.u.
- FPL's St. Lucie bus voltage was monitored for values outside of 1.00 p.u. and 1.06 p.u.
- All other monitored areas were monitored for values outside of 0.95-1.05 p.u.
- Generator buses and buses with nominal voltage below 69 kV were excluded from consideration.
- For P6 contingencies, buses were monitored for values outside of 0.88-1.10 p.u.
- Absolute change in bus voltage between base case and the interconnection case must have been greater than 0.02 p.u.

6. Study Results

As a member of the FRCC, DEF has been asked to conduct an Inverter Based Resource (IBR) study which includes other FRCC member entities' planned solar requests to assist them in assessing impacts to their system. The customer should note that this study may not follow DEF's interpretation of the Tariff and may not reflect request order in respect to this OASIS request thus impacts to DEF facilities were not considered in this coordinated study.

The thermal and voltage analyses did indicate that there are potentially impacted FRCC member entity systems. The IBR study results identified as significant impacts are shown in the Appendices below. The customer will need contact these potentially impacted parties identified below to confirm and resolve impacts to their system to maintain firm service. FRCC member entities may wait to identify themselves as an impacted party when this request is presented at the FRCC. FRCC member entities may invoke their right to review any or all their facilities that are suspected to be impacted by this interconnection request, which could result in additional impacted transmission system facilities to any initially identified. The customer may utilize contact information located below.

Potentially Affected Third-Party List

- FPL, GULF

N-1 Thermal Rate B Results

Contingency	Monitored Facility	kVs	Areas	Ureas Nam	Zones	Rate A (MVA)	Rate B (MVA)	Rate C (MVA)	Rate A %	Rate B %	Rate C %	Rate A %	Rate B %	Rate C %	Rate A Diff	Rate B Diff	Rate C Diff	Rate A Max Diff	Rate B Max Diff	Rate C Max Diff	Rate All Max Diff
P2-2:FPL:CLAU_1830	12355 MACEDON SW	115	50010	FPL-Q421_POI	115	1	115	30/1	SOCO/FPL	701/5	207	207	207								
P2-3:FPL:CLAU:1830-117	12355 MACEDON SW	115	50010	FPL-Q421_POI	115	1	115	30/1	SOCO/FPL	701/5	207	207	207	99.87	99.87	99.87	100.98	100.98	100.98	NEW	NEW
P2-3:FPL:CLAU:1830-144	12355 MACEDON SW	115	50010	FPL-Q421_POI	115	1	115	30/1	SOCO/FPL	701/5	207	207	207	99.87	99.87	99.87	100.98	100.98	100.98	NEW	NEW

N-1 Thermal Rate C Results

Contingency	Monitored Facility	kVs	Areas	Ureas Nam	Zones	Rate A (MVA)	Rate B (MVA)	Rate C (MVA)	Rate A %	Rate B %	Rate C %	Rate A %	Rate B %	Rate C %	Rate A Diff	Rate B Diff	Rate C Diff	Rate A Max Diff	Rate B Max Diff	Rate C Max Diff	Rate All Max Diff
P2-2:FPL:CLAU_1830	12355 MACEDON SW	115	50010	FPL-Q421_POI	115	1	115	30/1	SOCO/FPL	701/5	207	207	207								
P2-3:FPL:CLAU:1830-117	12355 MACEDON SW	115	50010	FPL-Q421_POI	115	1	115	30/1	SOCO/FPL	701/5	207	207	207	99.87	99.87	99.87	100.98	100.98	100.98	NEW	NEW
P2-3:FPL:CLAU:1830-144	12355 MACEDON SW	115	50010	FPL-Q421_POI	115	1	115	30/1	SOCO/FPL	701/5	207	207	207	99.87	99.87	99.87	100.98	100.98	100.98	NEW	NEW
P1-2_Branch:DEF:230-3161-FL GAS TRNS-230-3167-PERRY-230-1	3101 BAKER TP	115	3143	KILLEARN TP1	115	1	115	2	DEF	84	84	98	102	43.71	37.47	36	55.32	47.42	45.56	-	-
P7:DEF:6482_6485_6487-FLGT	3101 BAKER TP	115	3143	KILLEARN TP1	115	1	115	2	DEF	84	84	98	102	45.91	39.35	37.81	57.52	49.3	47.37	-	-
P7:DEF:STME-FLGT-PRRY	3101 BAKER TP	115	3143	KILLEARN TP1	115	1	115	2	DEF	84	84	98	102	45.91	39.35	37.81	57.52	49.3	47.37	-	-
P2-3:DEF:3151-PRRY	3101 BAKER TP	115	3143	KILLEARN TP1	115	1	115	2	DEF	84	84	98	102	45.51	39.01	37.48	57.04	48.99	46.97	-	-
P1-2_Branch:DEF:230-3161-FL GAS TRNS-230-3172-ST MARKS E-230-1	3101 BAKER TP	115	3143	KILLEARN TP1	115	1	115	2	DEF	84	84	98	102	47.84	41.01	39.4	59.53	51.03	49.03	-	-
P2-3:DEF:8492-STME	3101 BAKER TP	115	3143	KILLEARN TP1	115	1	115	2	DEF	84	84	98	102	47.85	41.01	39.4	59.18	50.73	48.74	-	-

N-1 Voltage Results

Contingency	Monitored Facility	kVs	Areas	Ureas Nam	Zones	Min Volt	Max Volt	05-Q211 BRK- Eosngp_246_B	06-Q211 BRK- Eosngp_246_S	STUDYBASE	07-Q211 BRK- Eosngp_246_B	08-Q211 BRK- Eosngp_246_S	STUDYBASE	09-Q211 BRK- Eosngp_246_S	Volt Diff
T-P2-1::DEF:115:BRDW-DFTN:(3104-3105-1)	2997 MICOSUKE CAP 115	115	2	DEF	84	0.9	1.05	1.0137	1.0675	NEW	1.017	1.0193	-	NEW	
T-P2-1::DEF:115:BRDW-DFTN:(3104-3105-1)	3101 BAKER TP 115	115	2	DEF	84	0.9	1.05	1.0113	1.0934	NEW	1.0146	1.0163	-	NEW	
T-P2-1::DEF:115:BRDW-DFTN:(3104-3105-1)	3104 BRADFPV W CAP 115	115	2	DEF	84	0.9	1.05	1.0114	1.1103	NEW	1.0146	1.0164	-	NEW	
T-P2-1::DEF:115:BRDW-DFTN:(3104-3105-1)	3115 LLOYD TP 115	115	2	DEF	84	0.9	1.05	1.0207	1.0553	NEW	1.0241	1.0165	-	NEW	
T-P2-1::DEF:115:BRDW-DFTN:(3104-3105-1)	3119 MICOSUKE TP 115	115	2	DEF	84	0.9	1.05	1.0139	1.0677	NEW	1.0173	1.0191	-	NEW	
T-P2-1::DEF:115:BRDW-DFTN:(3104-3105-1)	3143 KILLEARN TP1 115	115	2	DEF	84	0.9	1.05	1.0114	1.1059	NEW	1.0146	1.0164	-	NEW	
T-P2-1::DEF:115:BRDW-DFTN:(3104-3105-1)	6998 BUCK LK 115	115	2	DEF	307	0.9	1.05	1.0028	1.0572	NEW	1.0061	1.0083	-	NEW	
T-P2-1::DEF:115:BRDW-DFTN:(3104-3105-1)	7014 MICCOSK 115	115	2	DEF	307	0.9	1.05	1.0137	1.0675	NEW	1.017	1.0193	-	NEW	
T-P2-1::DEF:115:BRDW-DFTN:(3104-3105-1)	7030 BAKER 115	115	2	DEF	307	0.9	1.05	1.0113	1.0934	NEW	1.0145	1.0163	-	NEW	
T-P2-1::DEF:115:BRDW-DFTN:(3104-3105-1)	7051 LLOYD 115	115	2	DEF	308	0.9	1.05	1.0207	1.0553	NEW	1.0241	1.0164	-	NEW	
PS:FPL:138:MIAMI-RIVERSDE	806 CCG DS12 138	138	1	FPL	1	0.95	1.07	0.9522	0.9522	-	0.95	0.9499	NEW	NEW	
T-P2-1::FPL:730:OrangeRiver_Terry:(609-351-1)	283 ARCADIA 69	69	1	FPL	4	0.95	1.07	0.9538	0.9539	-	0.9519	0.946	NEW	NEW	
P2-3:FPL:FARMLIFE:227-248	5323 KEY KDS1 69	69	7	KEY	221	0.95	1.051	0.9935	0.9935	-	0.7168	0.6853	0.0315	0.0315	
P2-3:FPL:FARMLIFE:227-248	5324 KEY KWD 69	69	7	KEY	221	0.95	1.051	0.987	0.987	-	0.7081	0.6766	0.0315	0.0315	
P2-3:FPL:FARMLIFE:227-248	5325 KEY WSS 69	69	7	KEY	221	0.95	1.051	0.988	0.988	-	0.7086	0.6771	0.0315	0.0315	
P2-3:FPL:FARMLIFE:227-248	5320 KEY CT 69	69	7	KEY	221	0.95	1.051	1	1	-	0.7268	0.6954	0.0314	0.0314	
P2-3:FPL:FARMLIFE:227-248	5322 KEY SIPS 69	69	7	KEY	221	0.95	1.051	1	1	-	0.7268	0.6954	0.0314	0.0314	
P2-3:FPL:FARMLIFE:227-248	5326 KEY TSS 69	69	7	KEY	221	0.95	1.051	0.9865	0.9865	-	0.7085	0.6771	0.0314	0.0314	
P2-3:FPL:FARMLIFE:227-248	5328 KEY KDS2 69	69	7	KEY	221	0.95	1.051	0.9877	0.9877	-	0.7114	0.6802	0.0312	0.0312	
P2-3:FPL:FARMLIFE:227-248	5330 KEY SSS 69	69	7	KEY	221	0.95	1.051	0.9959	0.9959	-	0.7229	0.6917	0.0312	0.0312	
P2-3:FPL:FARMLIFE:227-248	5321 KEY S1S 69	69	7	KEY	221	0.95	1.051	0.991	0.991	-	0.7184	0.6874	0.031	0.031	
P2-3:FPL:FARMLIFE:227-248	5305 KEY S1S2 138	138	7	KEY	221	0.95	1.051	0.9883	0.9883	-	0.7174	0.6866	0.0308	0.0308	
P2-3:FPL:FARMLIFE:227-248	5303 KEY S1S1 138	138	7	KEY	221	0.95	1.051	0.9819	0.9819	-	0.7145	0.6843	0.0302	0.0302	
P2-3:FPL:FARMLIFE:227-248	5302 KEY BCS 138	138	7	KEY	221	0.95	1.051	0.9806	0.9806	-	0.7148	0.6848	0.03	0.03	
P2-3:FPL:FARMLIFE:227-248	5304 KEY CKS 138	138	7	KEY	221	0.95	1.051	0.969	0.969	-	0.7133	0.6845	0.0288	0.0288	
P2-3:FPL:FARMLIFE:227-248	5339 KEY BPS1 13.8	13.8	7	KEY	221	0.9	1.1	0.9835	0.9835	-	0.7673	0.7393	0.028	0.028	
P2-3:FPL:FARMLIFE:227-248	5301 BIGPINE 138	138	7	KEY	221	0.95	1.051	0.9586	0.9586	-	0.7217	0.6948	0.0269	0.0269	
P2-3:FPL:FARMLIFE:227-248	873 MARATHON 138	138	1	FPL	7	0.95	1.07	0.9298	0.9298	=	0.7249	0.702	0.0229	0.0229	
P2-3:FPL:FARMLIFE:227-248	877 CRAWLKEY 138	138	1	FPL	7	0.95	1.07	0.9154	0.9154	=	0.7286	0.7078	0.0208	0.0208	
P2-3:FPL:FARMLIFE:227-248	879 ISLMRDASCAP 138	138	1	FPL	7	0.95	1.07	0.9692	0.9692	-	0.7761	0.7559	0.0202	0.0202	

**Designated Network Resource Service Request
System Impact Study
for OASIS 95150056 (DNR) “St. Marks Solar”**



January 2022

Transmission Planning, Florida

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1. Executive Summary

The System Impact for the Duke Energy Florida, LLC (DEF) Transmission System was studied for the Designated Network Resource (DNR) request referenced by OASIS number 95150056. This DNR requests a maximum of 75 MW yearly received from St. Marks Solar resource located in Wakulla County, Florida and delivered to DEF Load within DEF's Area beginning 01/01/2024 thru 01/01/2100. Although the requested start is 01/01/2024, current study work indicates that the NRIS study associated with this has an ISD of 09/03/2024. Therefore, this was the assumed ISD for this request. At the completion of this report, St. Marks Solar is still in its Large Generator Interconnection Procedures (LGIP) process under Q291 and working on the execution of a Large Generator Interconnection Agreement (LGIA) for 74.9 MW summer/winter.

The Third-party results of this study did indicate that there are potentially impacted Third-Party systems. Third-parties screened in the results and other FRCC members may wait to identify themselves as an impacted party when this request is presented in subsequent FRCC-TTS coordination study. The customer will need to work with parties who identify themselves as impacted, to resolve impacts to their system to maintain firm service.

This study confirms that this unit can be reliably integrated in DEF's system and designated as a Network Resource for the period under study.

2. Point of Receipt, and Point of Delivery

The Point of Receipt is the generator referred to as “St. Marks Solar”, with the Point of Interconnection will be a new 230 kV terminal at DEF’s existing St. Marks East 230/69 kV substation located in Wakulla County, Florida.

The Point of Delivery is City of DEF’s Load, which is located in DEF's Balancing Area.

3. Model Development

Power flow models were built using the Siemens PSS®E power system simulation program and were based on the FRCC 2021 (RIs2-RP) series cases, which were the most recent models available at the time of the study. The model years to be studied for power flow impacts will be 2024 Summer, and 2026 Summer. The study case models added the appropriate additional MW summer/winter output to each base case. Any sensitivity work performed was based on the FRCC 2021 (RIs2-RP) series cases.

This resource was studied as being dispatched against other DEF resources that would otherwise be serving DEF’s Load.

4. Analyses Performed

Power flow analyses of the cases were performed using PowerGEM's TARA software (TARA) to determine the impact of the DNR on the Bulk Electric System (BES). The base and interconnection study cases were compared to determine if the DNR caused new overloads, voltage violations, or exacerbated existing thermal overloads. In addition, all 69 kV and above branch flows and bus voltages in the FRCC region were monitored.

The following contingencies were performed using the TARA AC Contingency Analysis Calculator:

- Selected TPL-001-4 Category P1, P2, P4, P5, P6 and P7 contingencies within the FRCC region as previously defined by FRCC transmission owners.

5. Screening Criteria

The following criteria were used for screening **thermal results**.

- Unrelated results from GSU transformers were excluded.
- Transmission system elements operated at less than 69 kV nominal voltage were excluded.
- System-intact overloads were screened at greater than 100 percent of rate A.
- Post-contingency overloads were screened at greater than 100 percent of rate A. An exception to using Rate A is the P6 contingencies, which were screened at Rate C.
- Post-contingency overloads that would be improved by the interconnection were excluded.
- Existing Post-contingency overloads were compared between the base and study cases, these overloads that increased were reviewed for significant impact.

The following criteria were used for screening **voltage results**.

- DEF and SECI buses were monitored for values outside of 0.90-1.05 p.u.
- FPL 69, 115, 138, and 230 kV buses were monitored for values outside of 0.95-1.07 p.u.
- FPL 500 kV buses were monitored for values outside of 0.95-1.10 p.u.
- TECO 69 kV buses were monitored for values outside of 0.925-1.05 p.u.
- TECO 138 and 230 kV buses were monitored for values outside of 0.95-1.06 p.u.
- FPL's Turkey Point bus voltage was monitored for values outside of 1.01 p.u. and 1.06 p.u.
- FPL's St. Lucie bus voltage was monitored for values outside of 1.00 p.u. and 1.06 p.u.
- All other monitored areas were monitored for values outside of 0.95-1.05 p.u.
- Generator buses and buses with nominal voltage below 69 kV were excluded from consideration.
- For P6 contingencies, buses were monitored for values outside of 0.88-1.10 p.u.
- Absolute change in bus voltage between base case and the interconnection case must have been greater than 0.02 p.u.

6. Study Results

6.1. Thermal Results

The evaluation of thermal results did not identify any network upgrades of DEF's transmission system required to accommodate the 75 MW DNR. The FPL/GULF bi-directional transfers have known constraints related to line sections associated with the Baker Substation which are not attributable to this resource under study. These constraints are planned to be resolved. Due to the inclusion of these transfers in the Sensitivity cases extensive results regarding the line sections have been paired down to show the worst overloads. These and other results identified as significant impacts can be found in the Appendices below.

6.2. Voltage Results

The evaluation of voltage results did not identify impacted facilities on DEF's transmission system required to accommodate the 75 MW DNR. The results identified as significant impacts can be found in the Appendices below.

6.3. Third-Party impacts

The thermal and voltage analysis did indicate that there are potentially impacted Third-Party systems. The results identified as significant impacts are shown in the Appendices below. Third-parties screened in the results and other FRCC members may want to identify themselves as an impacted party when this request is presented in subsequent FRCC-TTS coordination study. The customer will need to work with parties who identify themselves as impacted, to resolve impacts to their system to maintain firm service.

The customer should contact any Third-Parties identified below to initiate an affected system study pertaining to the impacted transmission system facilities identified in this study. Third-Parties may invoke their right to review any or all their facilities that are suspected to be impacted by this interconnection request, which could result in additional impacted transmission system facilities to any initially identified. The customer may utilize contact information located in the Appendices below.

Potentially Affected Third-Party List

- FPL, GULF, SOCO, TAL

N-1 Thermal Rate B Results

Contingency	Monitored Facility	kVs	Areas	Areas Name	Zones	Rate A (MW)	Rate B (MW)	Rate C (MW)	Rate A %											Rate A Diff	Rate B Diff	Rate C Diff	Rate A Max Diff	Rate B Max Diff	Rate C Max Diff																	
									09-0215-Rate A %	09-0215-Rate B %	09-0215-Rate C %	11-0215-Rate A %	11-0215-Rate B %	11-0215-Rate C %	14-0215-Rate A %	14-0215-Rate B %	14-0215-Rate C %	17-0215-Rate A %	17-0215-Rate B %							17-0215-Rate C %	20-0215-Rate A %	20-0215-Rate B %	20-0215-Rate C %													
T-P2-1-FPL138-McArthur_Lauderdale(162-524-1)	137 BROWARD	138	154 MARGATE		138	138	138	138	287	287	373	96.29	96.29	74.09	96.3	96.3	74.1	-	-	-	99.15	99.15	76.29	99.15	99.15	76.29	-	-	-	100	100	76.94	100.01	100.01	76.95	NEW	NEW	NEW	NEW	NEW	NEW	NEW

N-1 Thermal Rate C Results

Contingency	Monitored Facility	kVs	Areas	Areas Name	Zones	Rate A (MW)	Rate B (MW)	Rate C (MW)	Rate A %											Rate A Diff	Rate B Diff	Rate C Diff	Rate A Max Diff	Rate B Max Diff	Rate C Max Diff																		
									09-0215-Rate A %	09-0215-Rate B %	09-0215-Rate C %	11-0215-Rate A %	11-0215-Rate B %	11-0215-Rate C %	14-0215-Rate A %	14-0215-Rate B %	14-0215-Rate C %	17-0215-Rate A %	17-0215-Rate B %							17-0215-Rate C %	20-0215-Rate A %	20-0215-Rate B %	20-0215-Rate C %														
10024 N TIFTON	3101 BAKER TP	115	3143 KILLEARN TP1		115	2	DEF	84	84	98	102	120.35	103.16	99.11	123.98	106.27	102.1	3.63	3.11	NEW	40.36	34.59	33.24	44.97	38.54	37.03	-	-	-	105.56	90.48	86.94	109.43	93.79	90.11	3.87	-	-	3.87	3.11	NEW	NEW	NEW

N-1 Voltage Results

Contingency	Monitored Facility	kVs	Areas	Areas Name	Zones	Min Volt Limit	Max Volt Limit	11-0215-Volt			14-0215-Volt			17-0215-Volt			VOLT VS IEEE	ROW SUMMARY	VOLT MAX DIFF
								Volt	Volt	Volt Diff	Volt	Volt	Volt Diff	Volt	Volt	Volt Diff			
P1-1-3Wind1-DEF-69(115)JASPER SOUT-3089-3117-3132-1	3089 JASPER SOUTH	69	2	DEF	84	0.9	1.05	0.9221	0.9237	-	1.0488	1.0505	NEW	1.0483	1.0486	-	NEW	NEW	